ILLINOIS NATURAL HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

The Nature Conservancy's Emiquon Preserve

Fish and Aquatic Vegetation Monitoring

2016 Field Report

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Floodplain restoration monitoring of the aquatic vegetation and fish communities of The Nature Conservancy's Emiquon Preserve 2016

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Disclaimer

Under contract with The Nature Conservancy (TNC), fish and aquatic vegetation monitoring (2007-present) was conducted on Thompson and Flag lakes of the Emiquon Preserve by the Illinois Natural History Survey, Illinois River Biological Station (INHS-IRBS) in order to evaluate a series of key ecological attributes (KEA) relevant to restoration success. This report presents a summary of data collected for the 2016 field season with trends from previous year. The findings, conclusions, and views expressed herein are those of the researchers and should not be considered as the official position of TNC or the INHS.

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Executive Summary

In the tenth year since establishment, The Emiquon Preserve maintains a growing and healthy assemblage of aquatic vegetation and fish, with little indication that non-native species are becoming dominant or degrading environmental conditions in the immediate future. Of 19 relevant KEAs measured in 2016, 14 were indicators were measured in 2016 and 5 were not. Of the 14 KEA indicator's measured, 9 met the project goals, 5 did not and an additional 5 were not measured and cannot be assessed.

Vegetation Indicators

Out of the 5 submerged and emergent/floating-leafed aquatic vegetation goals established for the 2016 evaluation, 3 goals were met, 1 was not met, and 1 was not measured during the given time period of the KEA goal. Specifically;

- Water transparency: mean Secchi has met desired goals in all years except in 2012.
- Rate of change in water levels: levels more than 1.5 cm/day only 9% of the time and water level fluctuations did not exceed 1 m.
- Community composition of emergent/floating-leaved vegetation: no non-native emergent or floating-leaved vegetation was observed.
- Non-native Eurasian watermilfoil (*Myriophyllum spicatum*) made up 18 percent of abundance (the desired goal is less than 10%).
- Due to an unexpected position vacancy, vegetation samples not taken April-July.

Fish Indicators

Of the 14 fish community KEAs to be evaluated, 6 were met, 4 were not, and 4 were not measured. Specifically;

- 17 native species were collected in 2016. In fact, since 2007, the number of native species sampled in a single year has never met the goal of 25 or more. However the desired goal is met when cumulative diversity is considered - the cumulative richness exceeds 25 from 2013 to 2016. Abundance and biomass were well above their desired goals in 2016, with natives exceeding 99% of the community composition and 80 % biomass.

- The native predatory fish indicator in 2016, catch-per-unit-effort (CPUE) of largemouth bass was 30 fish/hr. which is categorized as poor.
- The relative weight of game species (largemouth bass, bluegill, pumpkinseeds, and black crappie) indicator is in the desired range, but continues to trend down.
- All young-of-year (YOY) fish consisted of native species.
- Dissolved oxygen levels remain above minimum levels required by fish during spawning.
- Although large woody debris is low, abundant aquatic vegetation provides shading.
- The water control structure was completed but was not open enough to allow riverine fish to enter Emiquon for nursery purposes.
- This lack of connection prevented the export of secondary production to the Illinois River.
- Aquatic vegetation was found 100 percent of the time in littoral areas though above the desired range of 25-40 percent. However, because this does provides shallow water habitat this KEA goal may be considered as being met.

Introduction

Historically, the backwaters that make up the Emiquon Preserve were among the most productive in the Illinois River Valley (IRV). These were subsequently disconnected from the Illinois River and reduced to agricultural drainage ditches by the 1930's and remained both drained and in continuous agricultural production, becoming one of the largest farms in Illinois through 2006. The Nature Conservancy purchased this property in 2000 and began aquatic restoration in 2007. As a part of the restoration, the surrounding levees were left in place but the drainage of accumulating water was discontinued and the drainage ditches were treated with rotenone, in an attempt to limit the risk from any non-native Common carp (*Cyprinus carpio*) that were living in the ditches. The preserve was allowed to naturally fill through precipitation and >30 native fish species were stocked by Illinois DNR based on historical records of both lakes (VanMiddlesworth et al. 2016, Havera et al. 2003). The staff of the Illinois Natural History Survey's Illinois River Biological Station has been monitoring the submerged aquatic vegetation and fish assemblages from 2007 to the present. The data collected is used to evaluate Key Ecological Attributes (KEAs) of restoration success. The 19 KEA's assessed in this report were developed in 2004 by the Emiquon Science Advisory Council (i.e. The Nature Conservancy and partners) to serve as the driving management tool for the Emiquon Restoration. The knowledge gained may aid in future management efforts at the Emiquon Preserve and other floodplain restoration efforts.

Methods

Submersed Aquatic Vegetation

Previously submersed aquatic vegetation density were estimated as percent coverage on a vegetation rake, while emergent, non-rooted floating-leaved, and rooted floating-leaved aquatic vegetation density is estimated by percent cover observed within a 2-m perimeter around the boat. All aquatic vegetation data were collected according to the U.S. Army Corps' of Engineers Upper Mississippi River Restoration-Environmental Management Program (UMMR-EMP) Long Term Resource Monitoring Program (LTRMP) aquatic vegetation monitoring protocols of Yin et al. (2000).

In 2016, vegetation sampling was expanded to include biomass in addition to relative species abundance using a box sampler method to better track changes in both biodiversity and productivity from the same sampling effort. A subsample is taken from a 1m², this subsample is

collected inside of the box sampler that is 9.28 m². A total of 20 samples were collected and placed in a bag and returned to the laboratory to be frozen until samples can be processed. To process each sample, the micro and macro invertebrates and seeds are rinsed off, each sample is then sorted and identified to species. To estimate biomass of each species, the sorted samples are placed in weighing boats to obtain a wet weight before being placed in a drying oven for 16-48 hours at ≥ 60 °C. Once the sample is dried it is weight again to obtain a dry weight. The difference between the wet weight and the dry weight is then calculated to obtain the biomass of each species per sample.

Fish Monitoring

Monthly fish sampling is conducted from April to October annually using a multiple gear approach at random and fixed sites. Sampling gear types include: pulse DC electrofishing runs (15 minutes of effort per site), fyke net sets (24 hours each), and mini-fyke net sets (24 hours each) at shoreline or pseudo-shoreline (used for shoreline gear) sites. In addition to the shoreline gears, tandem fyke net sets (24 hours each) and tandem mini-fyke net sets (24 hours each) are deployed at open water (pelagic) sites. Fish sampling was stratified by habitat (shoreline, open water, and ditch) and all gears were fished according to the LTRM fish monitoring protocols of Ratcliff et al. (2014).

Sampling Effort (2007-2016)

Submersed Aquatic Vegetation

In 2016, the first year of the box core sample method, a total of 20 samples were obtained at random sites across the preserve. A subsample of a 1 m² area was collected using a box sampler to collected vegetation.

Full-scale aquatic vegetation monitoring was not conducted in 2007 to reduce disturbance caused by boat and plant collections to allow establishment of aquatic vegetation during the first year of restoration. However, we did note the presence of aquatic plant species at Thompson Lake in 2007 while conducting fish monitoring. During 2008-2009, we began to monitor aquatic vegetation by sampling random littoral (<15 m from the shoreline) and pelagic (>15 m from the shoreline) areas at Thompson Lake. Sampling was conducted monthly at five random littoral and pelagic sites each during April-October and at 20 random littoral and pelagic sites each in July

during the peak of the growing season. Additionally, three east/west fixed site transects were sampled monthly at seven locations along each transect for aquatic vegetation from May-October. Flag Lake was not sampled from 2007-2009 due to insufficient water levels.

During 2010-2015, aquatic vegetation across the preserve was sampled using random samples that were spatially stratified into north, middle, and south units during the May-September time period. The number of sites sampled per unit was proportional to the surface area of each unit and was determined monthly. Sampling was conducted at 30 random sites each month during May, June, and September but at 60 random sites each month in July and August, during the peak of the growing season.

Fish Monitoring

In 2016, sampling was limited to July through October due to staff turnover but the monthly effort and methods were the same as annual effort between 2009 and 2015 except tandem nets were not set in 2015 and 2016; sampling was conducted monthly from April to October using a multiple gear approach at random and fixed sites. On an annual basis this totaled 28 electrofishing runs (15 minutes each), 28 fyke net sets (24 hours each), and 28 mini-fyke net sets (24 hours each) at shoreline or pseudo-shoreline (used for shoreline gear) sites. Seven tandem fyke net sets (24 hours each) and seven tandem mini-fyke net sets (24 hours each) were deployed at open water (pelagic) sites. Minnow traps were discontinued in 2009 because they were a less effective gear than mini-fyke nets. These gear totals were stratified to give a balanced assessment of the major habitats (shoreline, open water, and ditch). All gears were fished according to the LTRM fish monitoring protocols of Ratcliff et al. (2014).

Fish sampling in 2007 and 2008 differed due to water surface elevation at Emiquon. For instance, in 2007 sampling was conducted July-November (excluding September) using a multiple gear approach at fixed sites including 9 pulsed-DC electrofishing runs (15 minutes each), 12 fyke net sets (24 hours each), 12 mini-fyke net sets (24 hours each), and 25 minnow trap sets (24 hours each) at shoreline or pseudo-shoreline (used for shoreline gear) sites. Also, 2 tandem fyke net sets (24 hours each), 2 tandem mini-fyke net sets (24 hours each), 1 trammel net set (1.5-hour set) and 1 experimental gill net set (1.5-hour set) were deployed at open water (pelagic) sites. By comparison sampling in 2008 was conducted April-October at Thompson Lake using a multiple gear approach at random and fixed sites including 28 electrofishing runs

(15 minutes each), 28 fyke net sets (24 hours each), 28 mini-fyke net sets (24 hours each), and 25 monthly minnow trap sets (24 hours each) at shoreline or pseudo-shoreline (used for shoreline gear) sites. Seven tandem fyke net sets (24 hours each) and seven tandem mini-fyke net sets (24 hours each) were deployed at open water (pelagic) sites. Flag Lake was also sampled with two electrofishing runs (15 minutes each). Gill and trammel nets became fouled by aquatic vegetation and algae in 2007 and were discontinued in 2008.

Key Ecological Attributes (KEAs) Results for Submersed Aquatic Vegetation

KEA 1: Underwater Irradiance

Indicator: Secchi disc transparency

Desired Range: Where water depth is ≤1.5 m, Secchi disc reading should be ≥ half the maximum water depth during late spring/early summer.

Goal Met: Not measured

Met: 2007-2015

Not met:

Not measured: 2016

Notes:

- In 2016, sampling was not conducted from April-June, however the average July-October transparency reading was 55 cm in 2016. (Figure 1). Since data was not collected within the KEA parameters the mean Secchi disc transparency for each year was used.

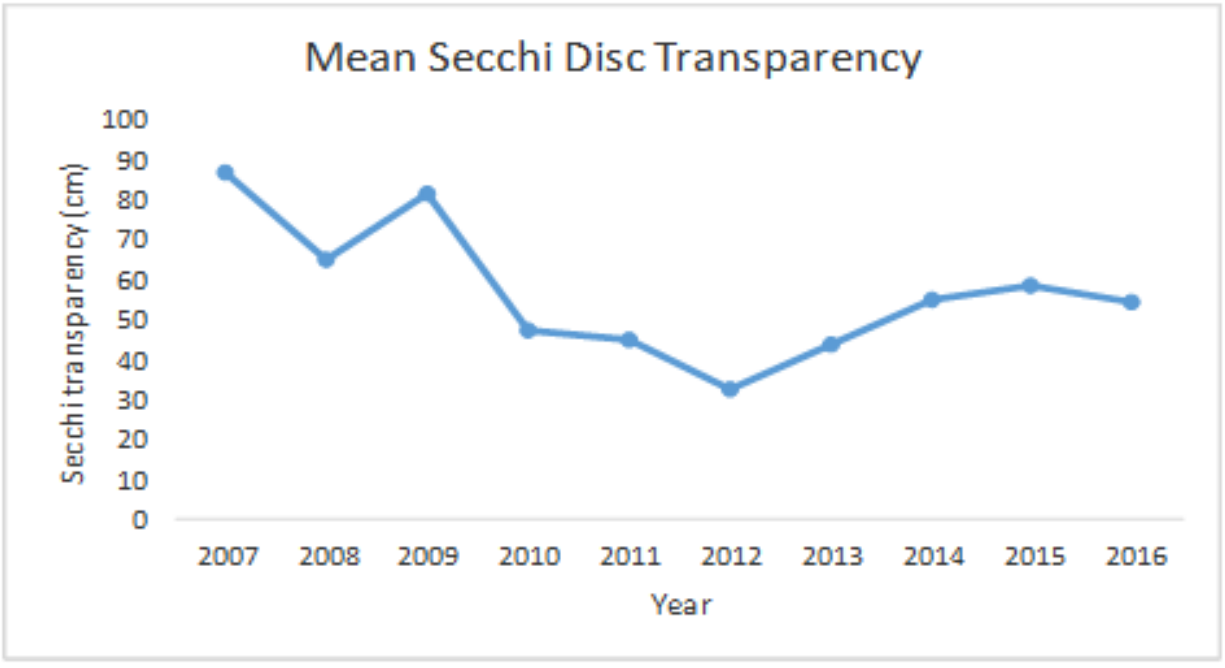

Figure 1

KEA 2: Hydrology

Indicator: Water depth

Desired Range: Rate of water rise should not exceed 1.5 cm/day during the growing season (May-September); water level fluctuations (rise) should not exceed 1 m total (May-September)

Goal: Met

Met: 2007-**2016**

Not met:

Not measured:

Notes:

- Daily water gauge data were collected by TNC from the Emiquon pump house.
- Excluding days where no data was collected or that were not within time period (May-September). The water level rose less than 1.5 cm/day 91 % of the time (Fig 2) and the water level did not exceed 1 m in 2016 (Fig 3).

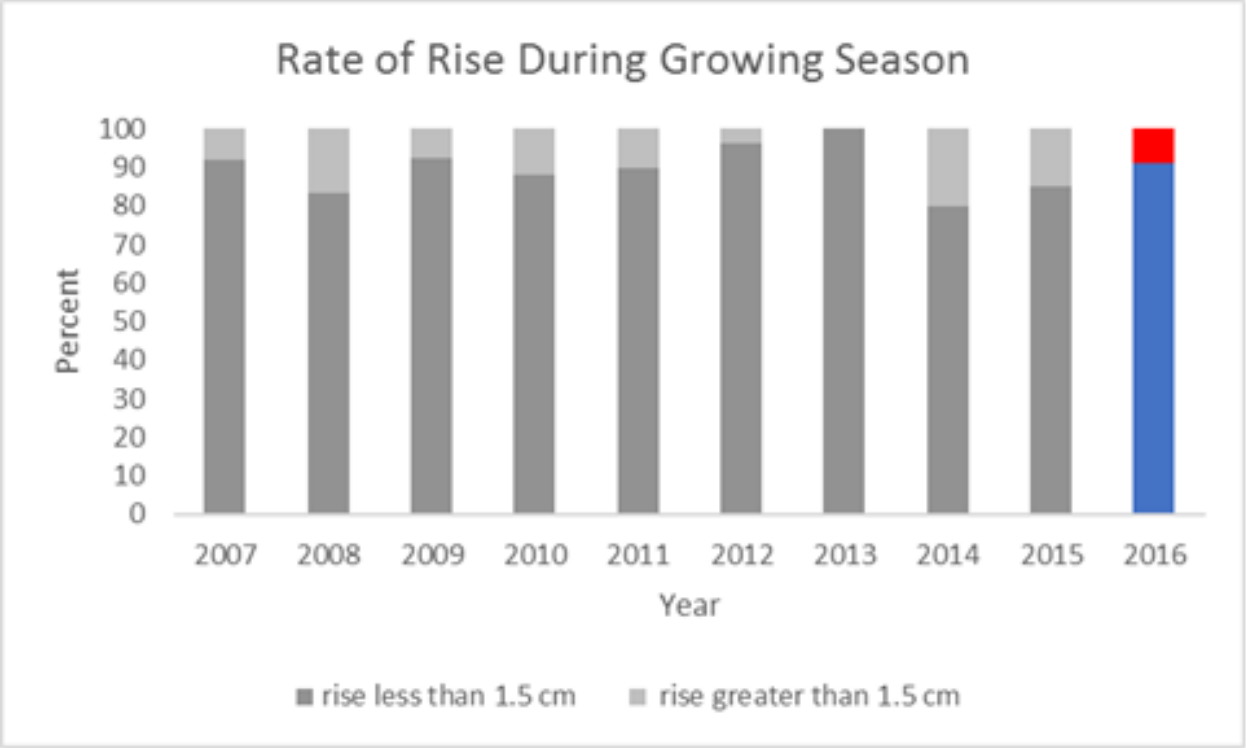

Figure 2

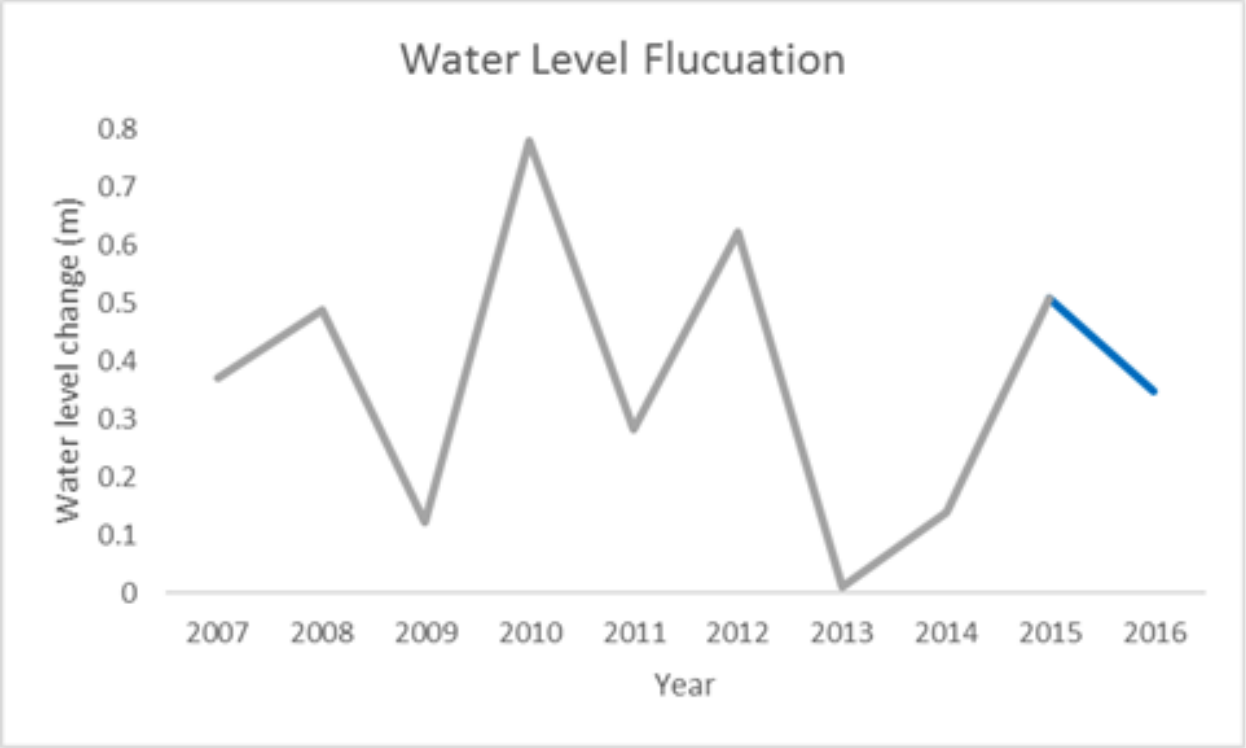
Water Level Flucuation
Water level change (m)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year

Figure 3

KEA 3: Community Composition

Indicator: Percent natives vs. invasive

Desired Range: ≤10% exotics, e.g., Eurasian watermilfoil *Myriophyllum spicatum*, curly-leaf pondweed *Potamogeton crispus*

Goal: Not met

Met: 2008 and 2009

Not met: 2010, 2011, 2012, 2013, 2014, 2015, and **2016**

Not measured: 2007

Notes:

- This goal was not measured in 2007.
- Non-Native species (Eurasian watermilfoil) made up 18 % which exceeds the desired range of ≤ 10 %.
- The unknown species consisted of stem pieces that could not be identified and made up less than 1 % of the total (Fig 4).

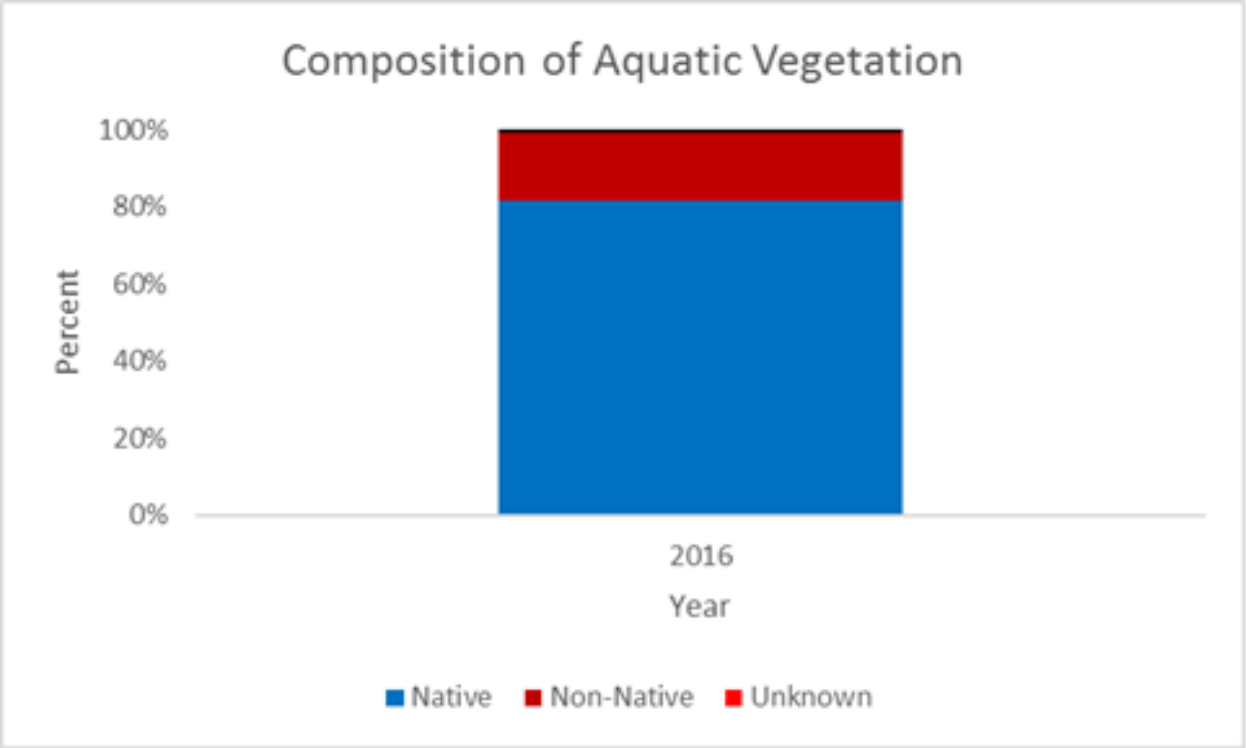

Figure 4

Key Ecological Attributes (KEAs) for Emergent/Floating- Leaved Plants

KEA 4: Hydrology

Indicator: Stable water depth

Desired Range: Rate of water rise does not exceed 1.5 cm/day during the growing season (May-September); Water level fluctuations (rise) do not exceed 1 m total (May-September)

Goal Met: Met

Met: 2007-**2016**

Not met:

Not measured**:**

Note:

- Daily water gauge data were collected by TNC from the Emiquon pump house. The goal was evaluated by excluding days where no data was collected and days that were not within time period (May-September).
- The water level rose less than 1.5 cm/day 91 % of the time (Fig 5) and the water level did not exceed 1 m in 2016 (Fig 6).

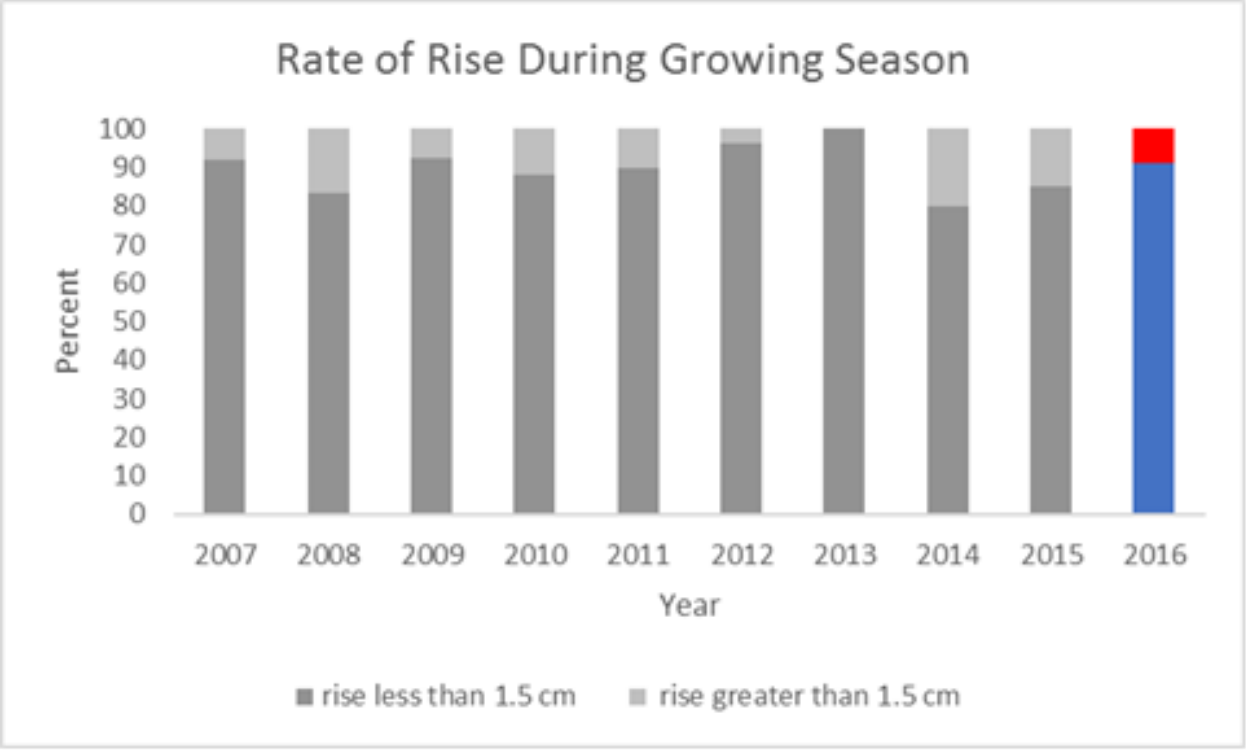

Figure 5

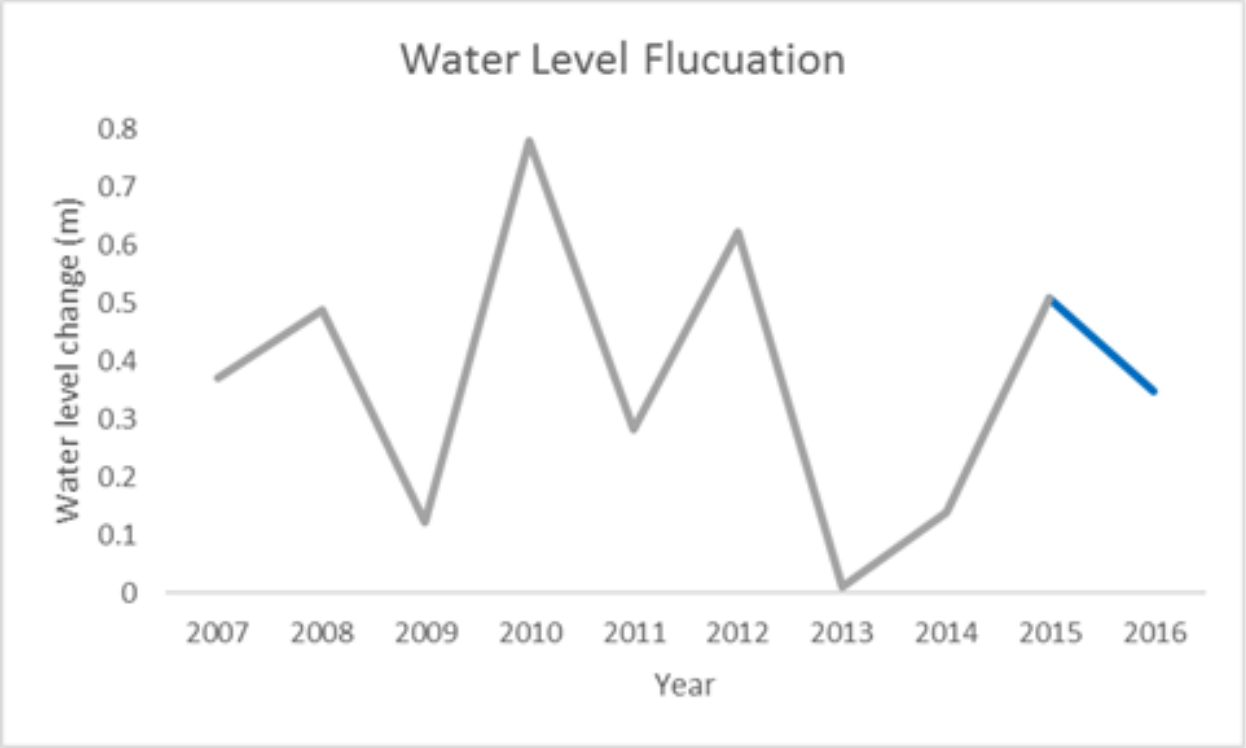

Figure 6

KEA 5: Community Composition

Indicator: Percent natives vs. invasive

Desired Range: ≥90% dominance by native species

Goal Met: Met

Met: 2007-**2016**

Not met:

Not measured**:**

Notes:

- Non-native emergent, non-rooted floating-leaved, and rooted floating-leaved aquatic vegetation were not observed during 2008-2015.

Key Ecological Attributes (KEAs) Results for Fish Assemblage

KEA 6: Fish Community Assemblage

Indicator: Number of native species populations

Desired Range: ≥25 native species represented (very good = ≥30 native species)

Goal not met: Not met

Met:

Not met: 2007-**2016**

Not measured:

Notes:

- The number of native fish species was calculated by taking the total catch of all fish in all gear types in each year.
- The number of native species present has been below 25 in all years. (Figure 7).
- Not all species are captured each year, so the total number of native fish species captured in any single year does not necessarily reflect total species richness.

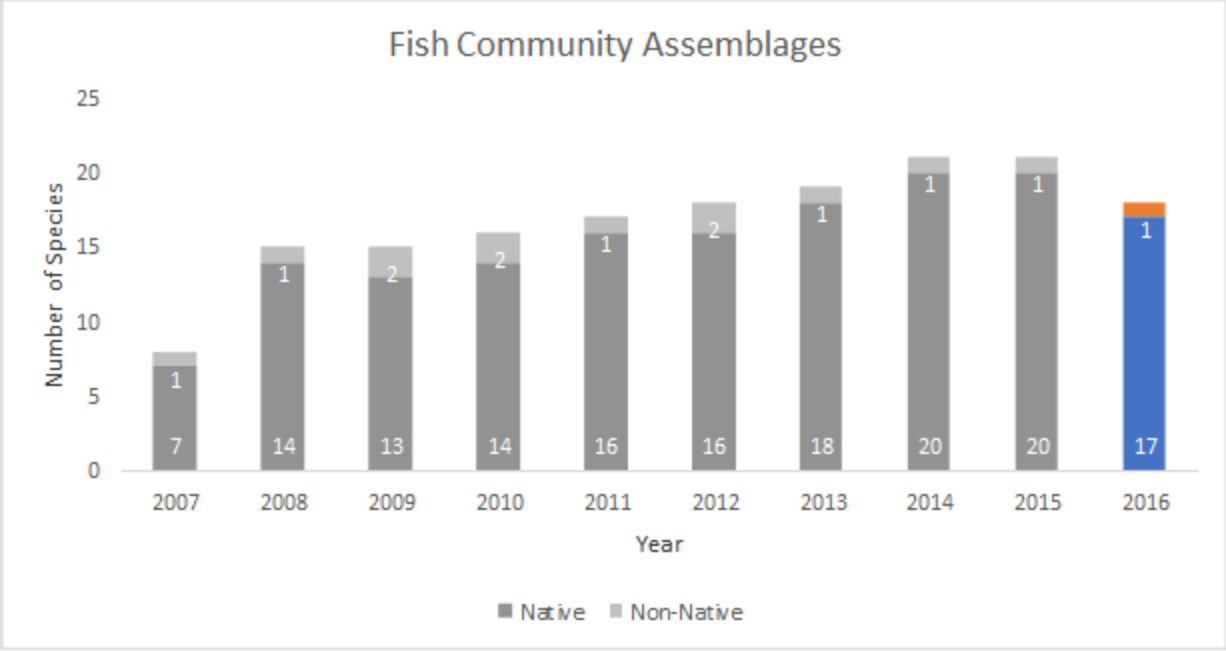

Figure 7

KEA 7: Fish Community Assemblages

Indicator: Number of native species populations

Desired Range: Native species ≥50% of number; Native species ≥50% of total biomass

Goal Met: Met

Met: 2007-**2016**

Not met:

Not measured:

Note:

- Native fish species dominated the fish community in 2016, representing 99% or more of the total catch (Figure 8). Native fish species represented 80% or more of the total biomass in 2016 (Figure 9).
- This indicator was calculated using all fish and all gear types in each year.

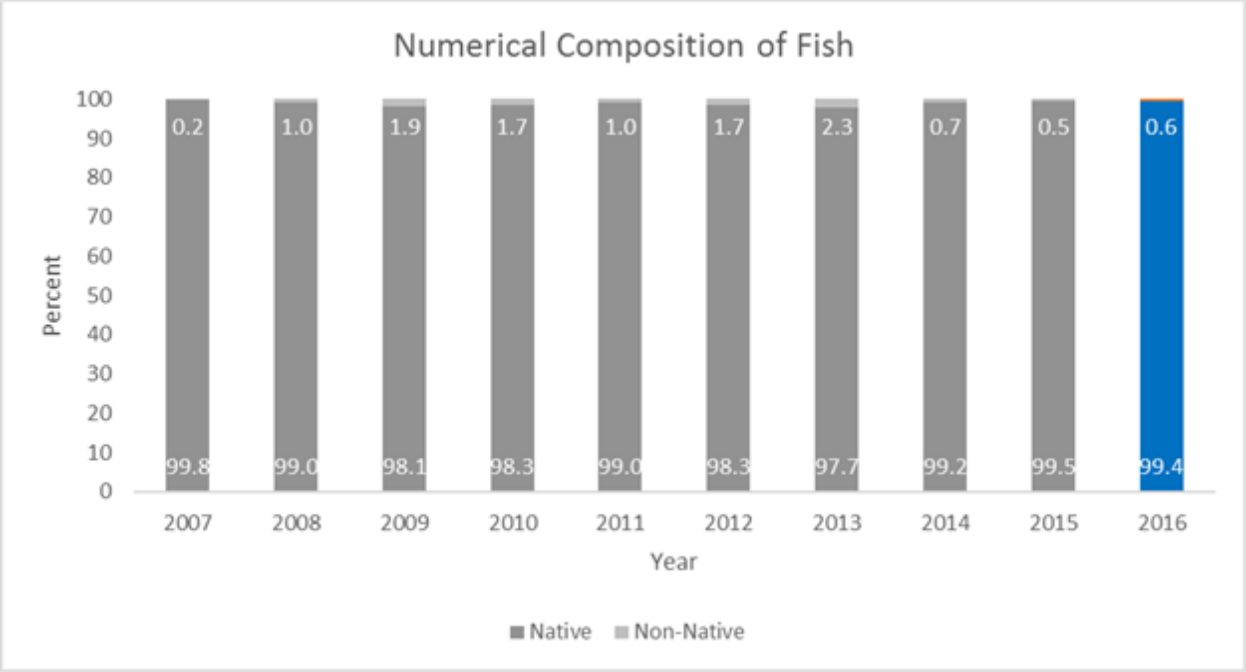

Figure 8

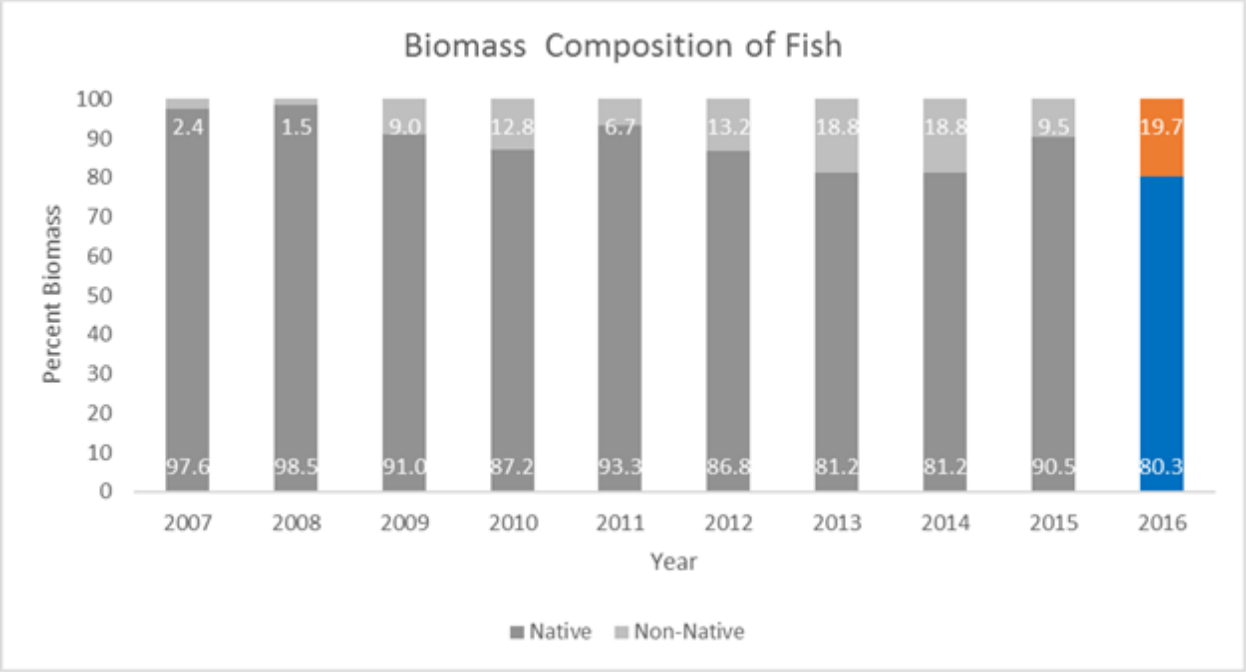
Biomass Composition of Fish
Percent Biomass
100
90
80
70
60
50
40
30
20
10
0
2.4
1.5
9.0
12.8
6.7
13.2
18.8
18.8
9.5
19.7
97.6
98.5
91.0
87.2
93.3
86.8
81.2
81.2
90.5
80.3
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year
Native
Non-Native

Figure 9

KEA 8: Fish Community Composition

Indicator: Body condition of native predatory fish population

Desired Range: Very good = ≥100 largemouth bass *Micropterus salmoides* CPUE while electrofishing and bowfin *Amia calva* present, good = 75-100 largemouth bass CPUE, fair = 50-75 largemouth bass CPUE, poor = <50 largemouth bass CPUE

Goal Met: Met (but poor)

Met: (with all types present): 2007 (very good), 2008 (good), 2009 (fair), 2010 (good), 2012 (good), 2013 (fair), 2015 (fair)

Not met: 2011 (poor), 2014 (poor), **2016 (poor)**

Not measured:

Notes:

- Bowfin are present every year from 2007 – 2016.
- Sampling did not begin until mid-season in 2016 thus there was less effort than in previous years. This lower effort likely skewed largemouth bass CPUE numbers towards the low end of the desired range.
- Largemouth bass CPUE was calculated using only day electrofishing (Figure 10). Mean largemouth bass CPUE was considered poor (< 50 largemouth bass/hr.) with CPUE being 30 largemouth/hr. (Figure10).

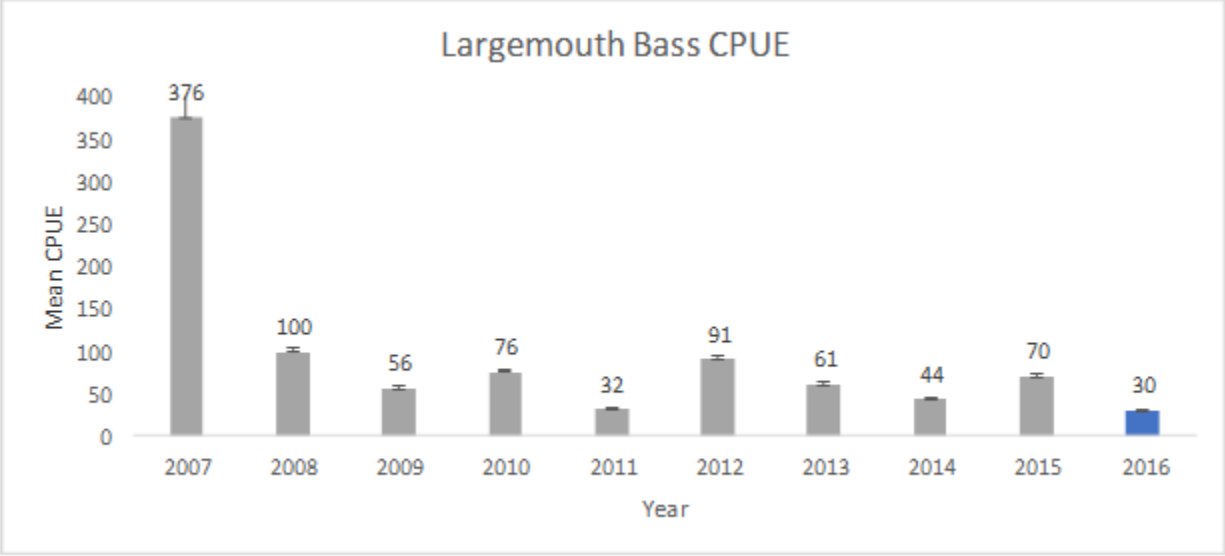

Figure 10

KEA 9: Spawning

Indicator: Water dissolved oxygen

Desired Range: 4 ppm oxygen (very good = ≥5 ppm and <200% saturation oxygen)

Goal Met: Met

Met: 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, and **2016**

Not met:

Not measured: <200 % Saturation oxygen not measured from 2007-2016

Notes:

- Fish and vegetation sites were each calculated separately using only sites in which dissolved oxygen was measured. Mean monthly (April-October) dissolved oxygen concentrations collected from all aquatic vegetation and fish sampling sites above the desired range and percent saturation was not measured from 2007 - 2016 (Figure 11).

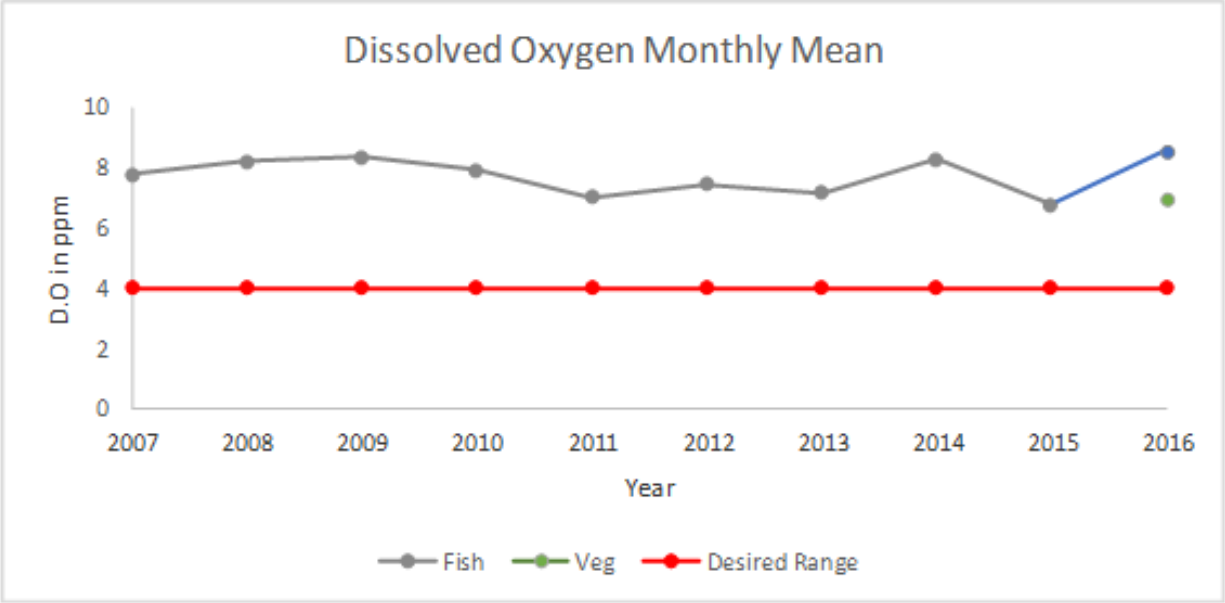

Figure 11

KEA 10: Spawning

Indicator: Substrate variability and structure (large woody debris)

Desired Range: Subset representing several of the following types present: diverse shoreline, shade, fallen trees, open areas, and submerged plants (very good = all types present)

Goal: Met

Met: with all types present: 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, and **2016**

Not met:

Not measured:

Notes:

- We noted the presence of several aquatic plant beds (mostly submersed and some emergent), along with minimal shoreline habitat diversity, open areas, large woody debris, and shade while conducting fish monitoring in 2007.
- There was an abundance of diverse shoreline habitats, open areas, as well as submersed, emergent, non-rooted floating-leaved, and floating-leaved aquatic vegetation from 2008-2016.
- Large woody debris and shading provided by them was minimal during these years, but shade was made abundant by aquatic vegetation.

KEA 11: Spawning

Indicator: Frequency of April/May connection to the river

Desired Range: Every three years for long-lived species, more frequently for short-lived species (very good = annual connection)

Goal Met: Not met

Met: 2013

Not met: 2007, 2008, 2009, 2010, 2011, 2012, 2014, 2015 and **2016**

Not measured:

Notes:

- The Emiquon Preserve was disconnected from the Illinois River during 2007-2016 except in 2013 when flood waters overtopped the levee.

KEA 12: Nursery

Indicator: Accessibility for riverine fish

Desired Range: Presence of YOY freshwater drum *Aplodinotus grunniens*, goldeye *Hiodon alosoides*, bigmouth buffalo *Ictiobus cyprinellus* (very good = all of the above plus paddlefish *Polyodon spathula*)

Goal: Not met

Met: 2013, 2015

Not met: 2007, 2008, 2009, 2010, 2011, 2012, 2014, and **2016**

Not measured:

Notes:

- No YOY freshwater drum, goldeye, or bigmouth buffalo were present in the 2016
- Young-of-the-year (YOY) freshwater drum, goldeye, bigmouth buffalo, and paddlefish were absent in our collections during 2007-2013. In 2014, one adult freshwater drum and one adult bigmouth buffalo were collected. One YOY freshwater drum was collected in 2015.

KEA 13: Nursery

Indicator: Native fish larvae

Desired Range: Dominance of native species

Goal: Met

Met: 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, and **2016**

Not met:

Not measured:

Notes:

- All fish were considered young-of-the-year (YOY) if they measured less than 100 mm in length. No Non-Native YOY fish larvae were collected in 2016 (Figure 12).

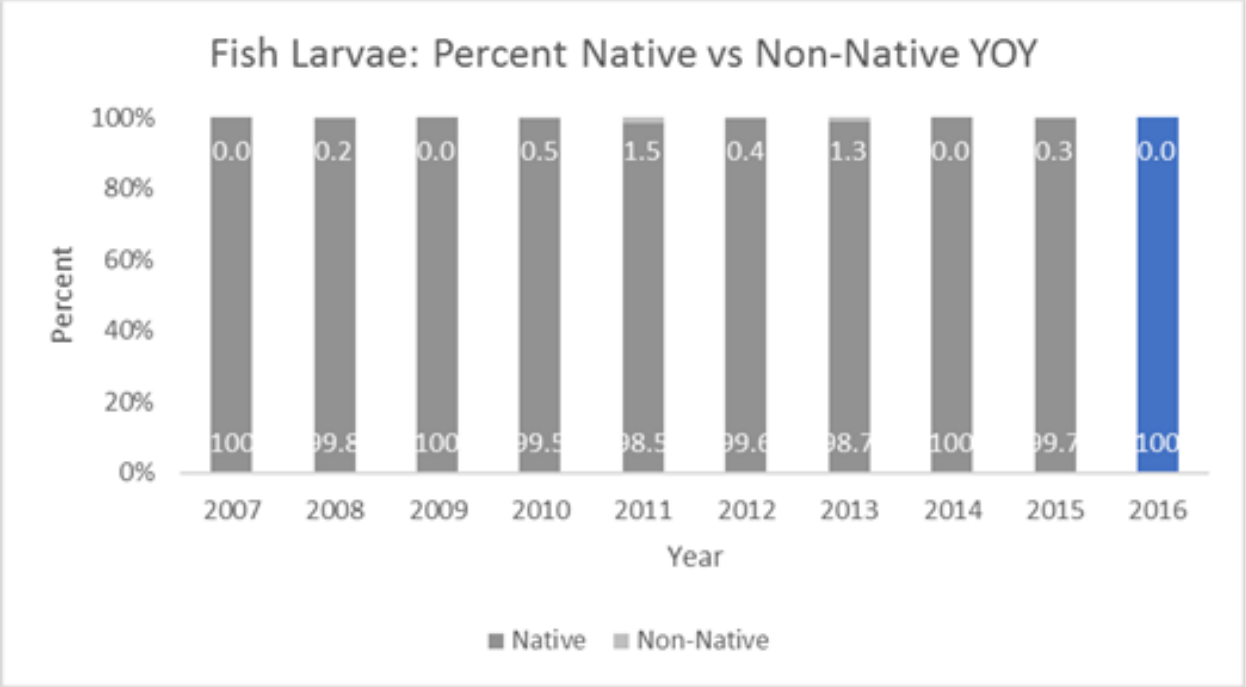

Figure 12

KEA 14: Feeding

Indicator: Presence of adults in good body condition

Desired Range: Mean relative weights 90-110%

Goal: Met

Met: 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015 and **2016**

Not met:

Not measured:

Notes:

- Mean relative weight for largemouth bass remained the same as it was in the previous year holding steady at 93 (Figure 13). Bluegill, pumpkinseed, and black crappie relative weights all showed declines in relative weights from previous years (Figures 14, 15, 16).
- Mean relative weight (Wr) for largemouth bass *Micropterus salmoides,* bluegill *Lempomis macrochirus,* pumpkinseed *Lempomis gibbosus,* black crappie *Pomoxis nigromaculatus,* were assessed using national data in the Fisheries Techniques, third edition (Zale, Parrish, and Sutton 2012).

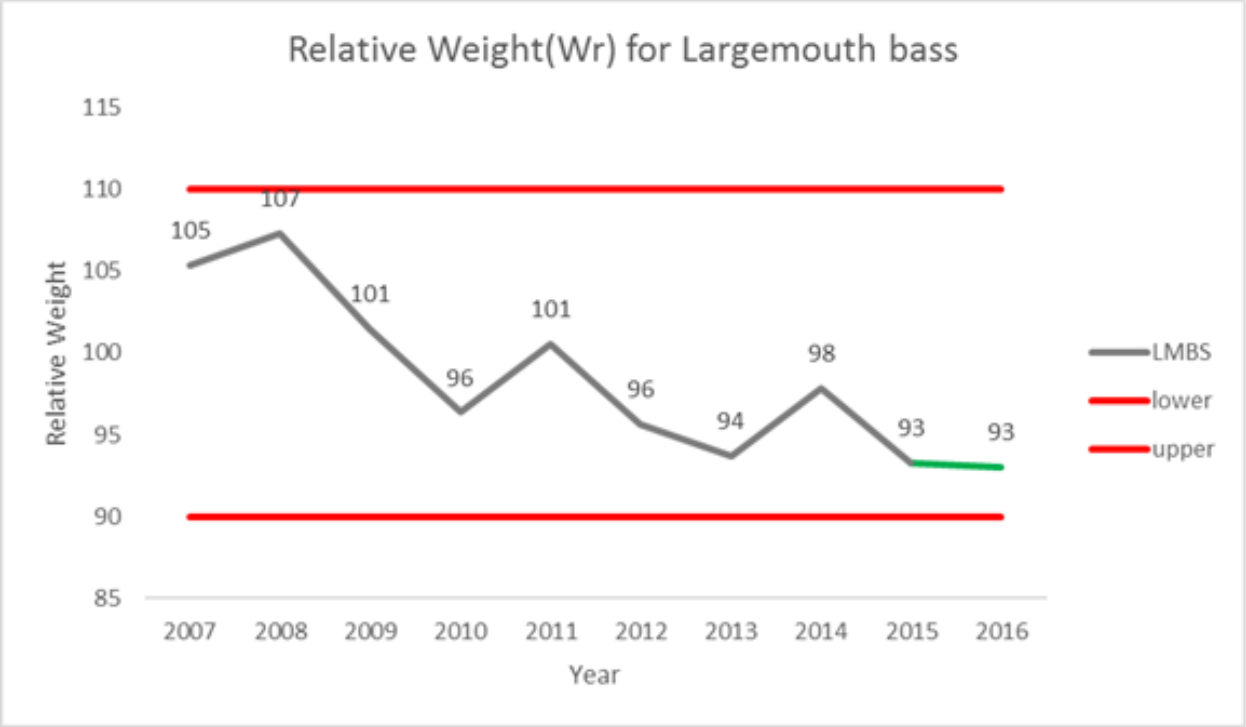

Figure 13

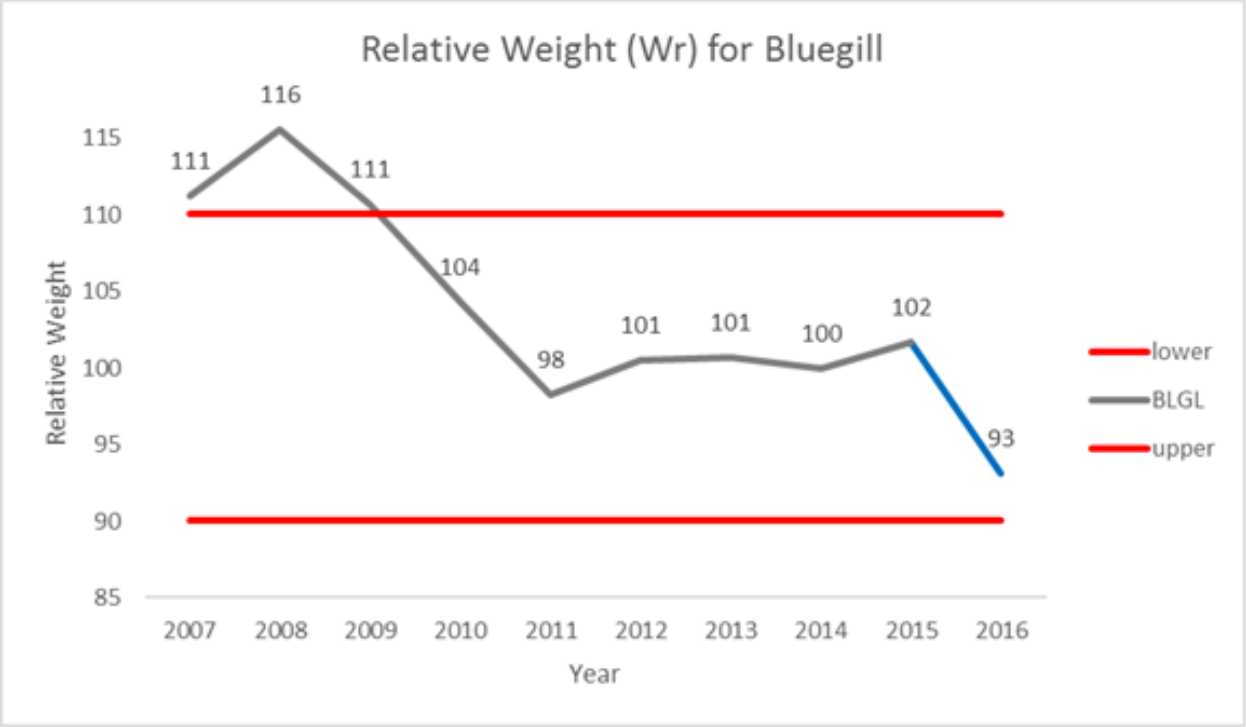

Figure 14

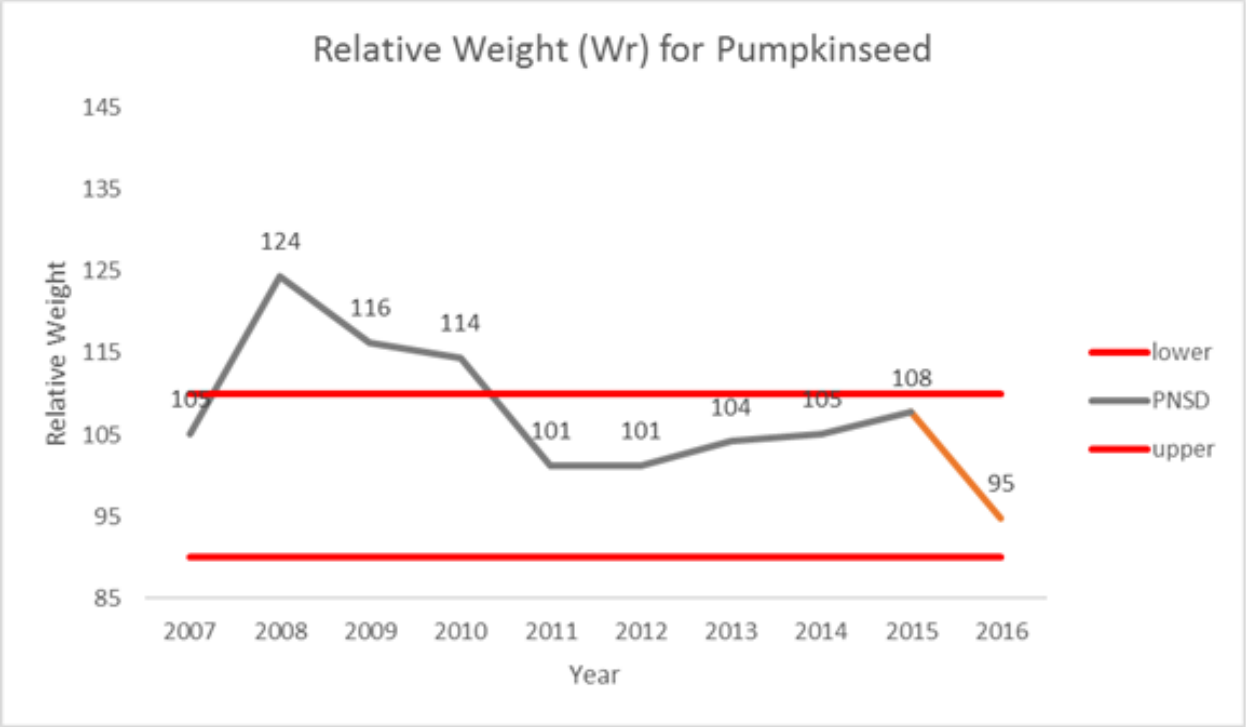

Figure 15

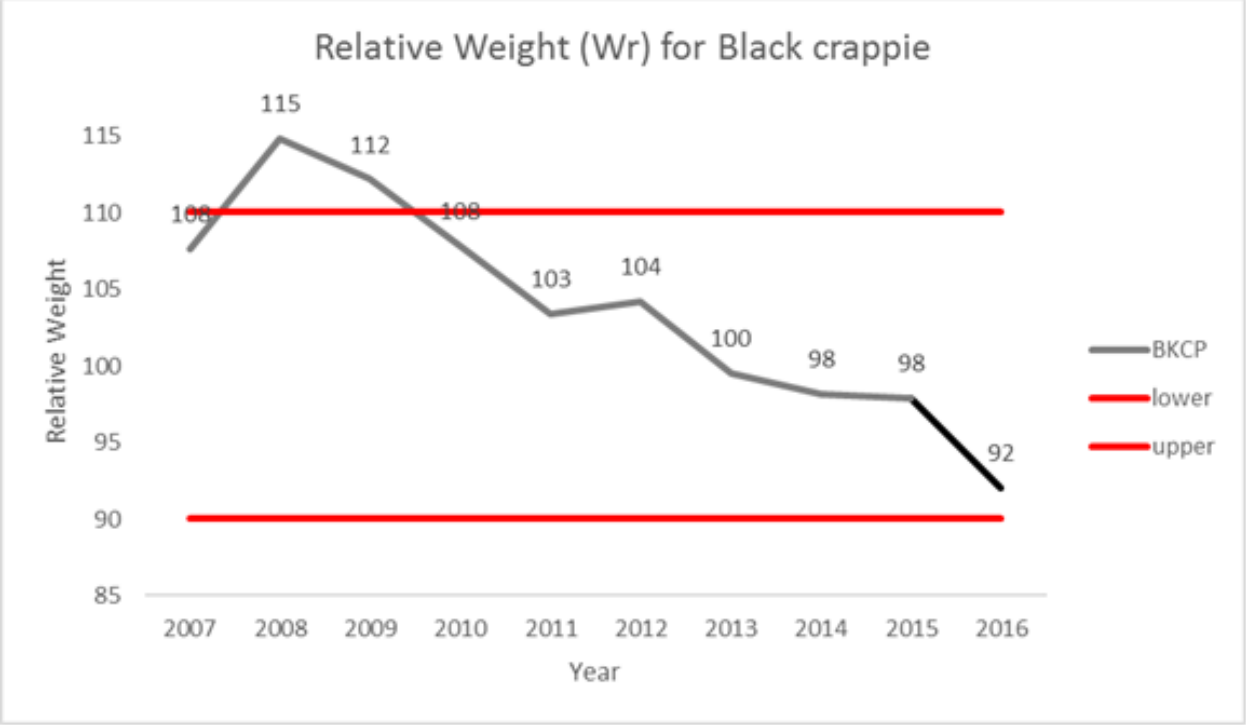

Figure 16

KEA 15: Feeding

Indicator: Distribution of abundant aquatic vegetation

Desired Range: 25-40% of the littoral area contains abundant vegetation during July-August

Goal: Met

Met: 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015 and **2016**

Not met:

Not measured: 2007

Notes:

- Out of all littoral (≤1.5 m water depth) aquatic vegetation sites during July-August, contained aquatic vegetation 100 % of the time.

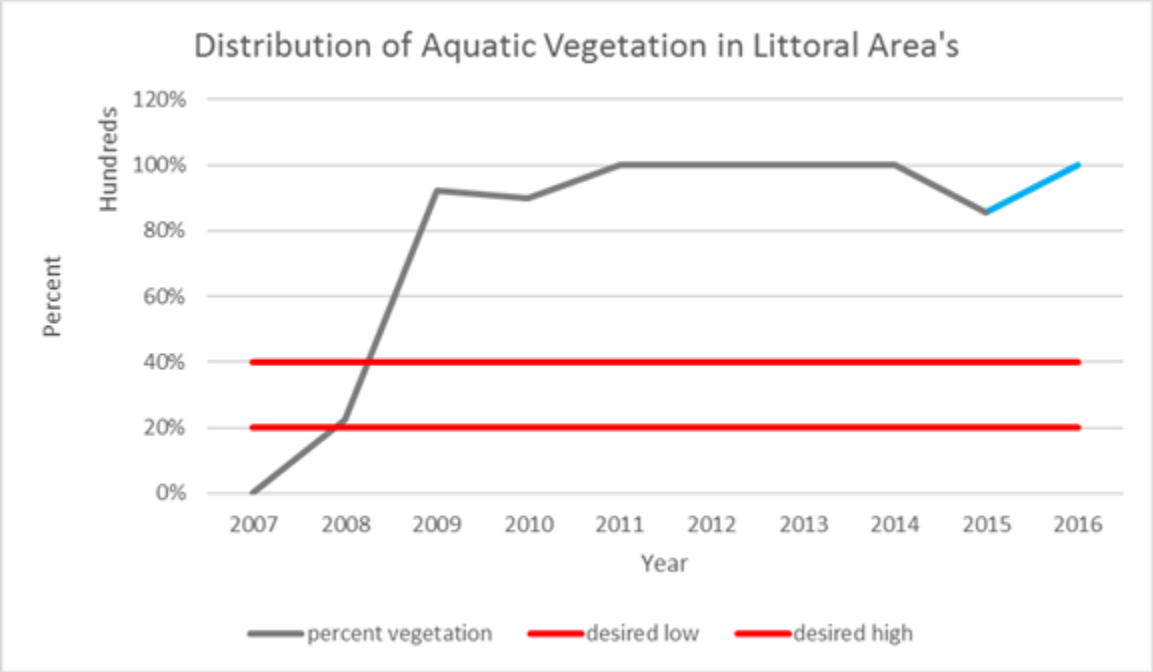

Figure 19

KEA 16: Over-wintering

Indicator: Percent of deep (oxygen rich) water

Desired Range: Water depth (5% >3 m, 10% 2-3 m, 25% 1-2 m, 60% <1 m); Dissolved oxygen (4.0-6.0 ppm at 2 m depth); Water temperature ≥1 °C (34 °F) at 2 m depth

Goal: Not Measured

Met: 2011, 2013, and 2015

Not met:

Not measured: 2007, 2008, 2009, 2010, 2012, 2014, and **2016**

Notes:

- The persistence of high numbers of native fish species across years provides indirect evidence that fish have been over-wintering successfully at the Emiquon Preserve.
- Winter fish sampling was not conducted in from 2007-2010 and 2012, 2014, and 2016 due to gear unavailability.

KEA 17: Over-wintering

Indicator: Presence of backwater species

Desired Range: Water temperature ≥34 °F based on the needs of freshwater drum (Bodensteiner & Lewis 1992)

Goal: Not measured

Met: 2011, 2013, 2014, and 2015

Not met:

Not measured: 2007, 2008, 2009, 2010, 2012, and **2016**

Notes:

- Freshwater drum were not present in fish samples 2016 and only three freshwater drum have ever been collected since 2007.
- Winter fish sampling was not conducted in from 2007-2010 and 2012-2015 due to gear unavailability.

KEA 18: Over-wintering

Indicator: Concentrations of over-wintering native species

Desired Range: Maximum electrofishing CPUE (hot spots) for wintering native species exclusive of gizzard shad *Dorosoma cepedianum* and minnows >1500 individuals/hr. and >5 species (very good = >2000/hr.)

Goal: Not Measured

Met:

Not Met: 2012, 2015

Not measured: 2007, 2008, 2009, 2013, 2014, and **2016**

Notes:

- Winter electrofishing was not conducted in 2016.

KEA 19: Feeding

Indicator: Secondary production delivered to the river

Desired Range: Export of plankton, macroinvertebrates, and fish to the river

Goal: Not Measured

Met:

Not met:

Not measured: 2007-2016

Note:

- Although not quantified, secondary production likely occurred when an estimated 204 million gallons of Emiquon water was pumped to the Illinois River between January 5-7, 2008 and an estimated 7 billion gallons of water from February 24, 2010 through September 23, 2010.
- Indicator not measured because The Emiquon Preserve has been disconnected from the Illinois River during 2007-2016 except in 2013 when the levee overtopped with flood waters.

Publications Produced by the Project

Peer reviewed

Van Middlesworth TD, Sass GG, Ray BA, Speir TW, Lyons J, McClelland NN and AF Casper. Food habits and relative abundances of bowfin, spotted gar, and largemouth bass: Implications for controlling common carp. Hydrobiologia (River Floodplain Restoration Special Issue, Online: 29 July 2016: 1 – 13). **DOI: 10.1007/s10750-016-2866-8**.

Sparks RE, Blodgett KD, Casper AF, Hagy HM, Lemke MJ, Machado-Velho LF and L Cleide-Rodrigues. Why experiment with success? Opportunities and risks in applying assessment and adaptive management to the Emiquon floodplain restoration project. Hydrobiologia (River Floodplain Restoration Special Issue, Online: 12 May 2016:1 – 24). **DOI: 10.1007/s10750-016-2785-8**

Van Middlesworth TD, McClelland NN, Sass GG, Casper AF, Spier TW and MJ Lemke. Fish community succession and biomanipulation to control two common aquatic ecosystem stressors during a large-scale floodplain lake restoration. Hydrobiologia (River Floodplain Restoration Special Issue: 1-16). **DOI: 10.1007/s10750-016-2696-8.**

Sparks RE, Blodgett KD, Casper AF, Hagy HM, Lemke MJ, Machado Velho LF and LC, Rodrigues. 2016. Why experiment with success? Opportunities and risks in applying assessment and adaptive management to the Emiquon floodplain restoration project. Hydrobiologia (River Floodplain Restoration Special Issue) **DOI: 10.1007/s10750-016-2785-8.**

Theses and Dissertations

Van Middlesworth M. 2016. Comparison of intersex prevalence and vitellogenin levels in common carp (*Cyprinus carpio*) and channel catfish (*Ictalurus punctatus*) in relation to landscape and local attributes in a floodplain river system. Theses presented for Masters of Science degre3e in Natural Resources and Environmental Sciences from the University of Illinois Urbana-Champaign.

Conferences

Casper, AF. 2016. Restoration in Floodplain Rivers: Expectations, Experiences, and Controversies. Dept. of Biology Western Illinois University, Macomb IL.

Casper, AF. 2016 - Ecosystem Responses to Asian carp Invasion and Removal: Plankton patterns, native fish trends, and Asian carp population dynamics. Presented at the Asian carp monitoring and response workgroup annual science review held February in Springfield IL. Sponsored by the Illinois DNR, Aquatic Nuisance Species Program.

Technical Reports

Mendenhall, O.M., Gibson-Reinemer, D.K., VanMiddlesworth, T.D, Casper, A.F. The Nature Conservancy's Emiquon Preserve Fish and Aquatic Vegetation Monitoring 9-Year (2007-2015) Report. Illinois Natural History Survey Technical Report 2017(17). http://hdl.handle.net/2142/96020

VanMiddlesworth TD and AF Casper. The Nature Conservancy's Emiquon Nature Preserve Fish and Aquatic Vegetation Monitoring Annual Report. Illinois Natural History Survey Technical Report 2016 (16). http://hdl.handle.net/2142/90091

Additional (Non-Monitoring) Fish Projects

Mark-Recapture estimation of population sizes Largemouth Bass and Black Crappie: All field sampling completed in 2015, statistical analysis completed in 2016, Technical Report available online in 2017 (http://hdl.handle.net/2142/95738)

NSF 2013 Pre-/Post-flood response grant: All sampling complete by 2015, statistical analysis complete by 2016, manuscript *In Press* for 2017 in Hydrobiologia Emiquon special issue

Merwin monitoring and summary report: All samples up to 2016 done, summary report up to 2014 done and available through U of I library (http://hdl.handle.net/2142/55152)

Comparison of reproductive condition (egg counts, GSI, LSI) of river versus Emiquon fish: All samples collected in 2015, statistical analysis of Common carp and catfish completed in 2016, Common carp and catfish manuscript *in progress* in 2017, Largemouth bass and Black crappie samples are not processed as of 2016

Comparison of Intersex condition prevalence in river versus Emiquon fish: All samples collected in 2015, statistical analysis of Common carp and catfish completed in 2016, Common carp and catfish manuscript *in progress* in 2017, Largemouth bass and Black crappie manuscript by Fritts et al. submitted to peer-review

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Havera, Stephen P., and Lynn L. Anderson. The Thompson Lake/Emiquon Story. Illinois Natural History Survey, 2003. Print.

Ratcliff, E. N., E. J. Gittinger, T. M. O'Hara, and B.S. Ickes. 2014. Long Term Resource Monitoring Program Procedures: Fish Monitoring, 2nd edition. A program report submitted to the U.S. Army Corps of Engineers' Upper Mississippi River Restoration-Environmental Management Program, June 2014. Program Report LTRMP 2014-P001, 88 pp. including Appendixes A–G, http://pubs.usgs.gov/mis/ltrmp2014-p001/.

Van Middlesworth TD, Sass GG, Ray BA, Speir TW, Lyons J, McClelland NN and AF Casper. Food habits and relative abundances of bowfin, spotted gar, and largemouth bass: Implications for controlling common carp. Hydrobiologia (River Floodplain Restoration Special Issue, Online: 29 July 2016: 1 – 13). DOI: 10.1007/s10750-016-2866-8.

Yin, Y., J.S. Winkelman, and H.A. Langrehr. 2000. Long Term Resource Monitoring Program Procedures: Aquatic Vegetation Monitoring. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI.

Zale, A.V., D.L. Parrish, and T.M. Sutton, editors. Fisheries Techniques, 3rd edition. American Fisheries Society, Bethesda, MD. Length, weight, and associated indices. Pages 637-670.